Rapid III Spacecraft
PROTEUS Data Package

PROTEUS Platform Heritage

The Thales Alenia Space PROTEUS platform is a cost effective and flight proven platform that is applicable to Low Earth Orbit space missions and has more than 18 years cumulated flight heritage.

The PROTEUS platform was developed by Thales Alenia Space in partnership with the French Space Agency CNES from 1996 to 2000, with the goal to design and qualify a small and versatile satellite bus as well as a generic ground segment that is able to accommodate a variety of different payloads. The PROTEUS platform is a multi-mission platform capable of supporting all types of Earth environmental and science missions.

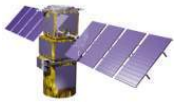
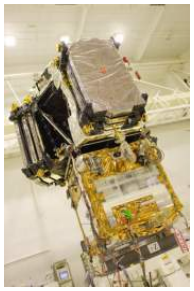
The PROTEUS platform was successfully qualified through the JASON 1 program, launched at the end of 2001, with all mission requirements fulfilled. Four successful missions have followed using same PROTEUS platform. The JASON 3 mission is currently under assembly.

The PROTEUS platform has therefore demonstrated its capability to host a large range of payloads, with enhanced performances currently under development.

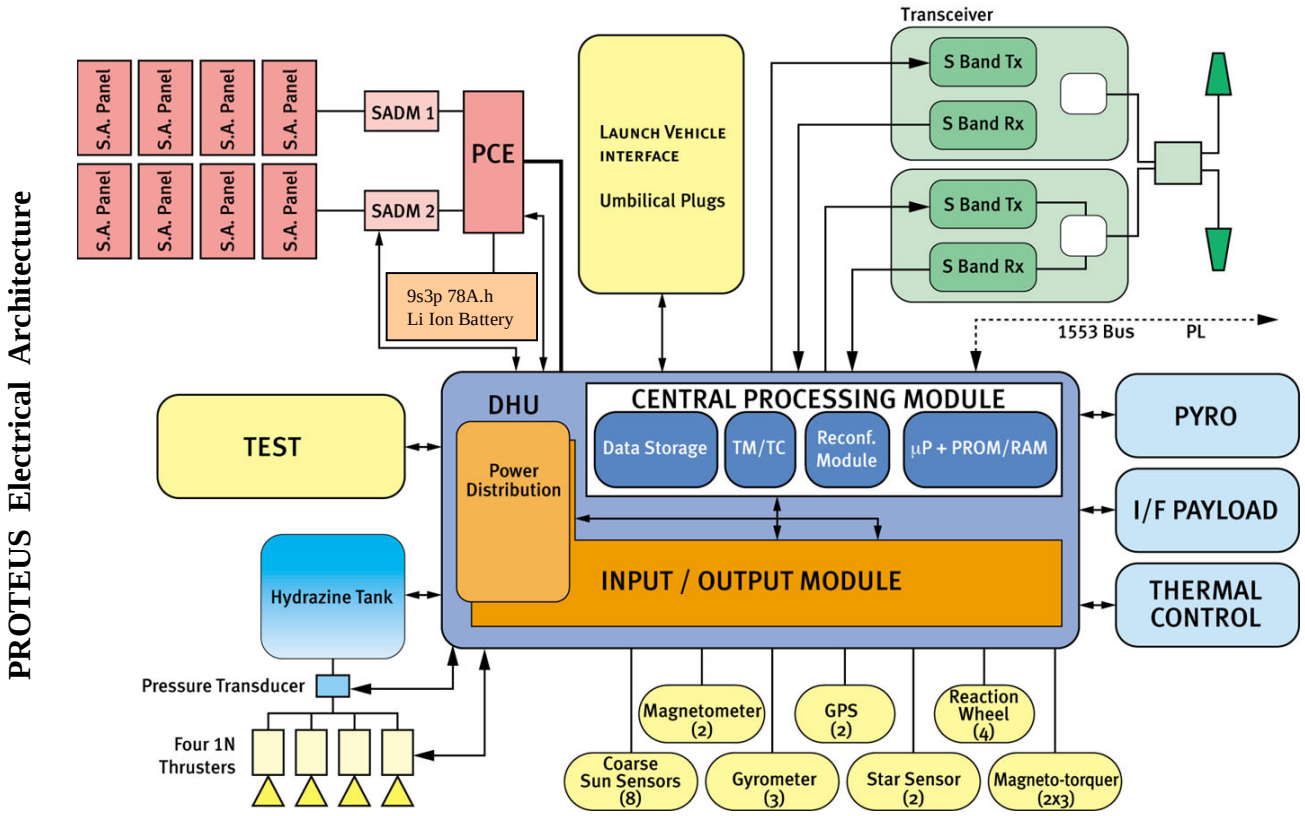
Avionics Architecture

The PROTEUS Command and Control design relies on a fully centralised architecture in a single computer: the Data Handling Unit (DHU). The DHU runs the OBSW, implements the HW part of the failure detection and recovery, and distributes power towards Payload (P/L) and Platform (P/F) units.

All units are internally or externally redundant including the micro-processor inside the DHU. The resulting PROTEUS platform reliability is close to 0.9 over three years. The Jason 1 satellite with the PROTEUS platform has been in continuous operation for over 9 years. The platform availability is better than 99% in worst case including failures recovery, radiation effects and orbit correction maneuvers (15 minutes per month).

JASON-1	CALIPSO	COROT	JASON-2	SMOS
				
NASA / CNES	NASA	CNES/ESA	NASA / CNES	ESA/CNES
Ocean Altimeter	Atmosphere (optical / Lidar)	Astronomy (optical)	Ocean Altimeter	Ocean salinity (RF)
1336 km/ 66°	14 Hr orbit	Polar orbit	1336 km/ 66°	6-18Hr orbit
				
Launched in 2001 on Delta 2	**Launched in 2006 on Delta 2**	**Launched in 2006 on Soyuz**	**Launched in June 2008 on Delta 2**	**Launched in 2009 on Rockot**

PROTEUS Platform flight heritage



TT&C Capability

The PROTEUS S-Band Telemetry (TM) and Tele-Command (TC) is compatible with small Ground stations with a 2.8 m antenna. The CCSDS packet standard protocol is used for both TM encoding and TC decoding.

Power Supply Chain

Electrical power is generated by two symmetric solar wing arrays attached near the satellite centre of mass with two single-axis stepping motor drives. The resulting surface is close to 10m².

Power is distributed through a single unregulated bus (23V-37V). A Digital Series Regulator, implemented inside the PCE (Power Conditioning Equipment), manages the Li-Ion battery charge.

Two identical power lines are routed from the PCE to the Data Handling Unit (DHU), with the power distribution function centralized in the DHU. Power bus protection is performed by fuses and relays inside the DHU and double isolation on circuits upstream from the fuses.

Attitude Control

The PROTEUS in-orbit platform attitude control is based on a gyro-stellar concept. Three accurate 2-axis gyrometers are used for stability requirements and attitude propagation. Both star trackers are accommodated on the payload in a Star Tracker Assembly that is equipped with autonomous thermal control. Attitude in safe mode is obtained using magnetic and solar measurements (with two 3-axis magnetometers and eight coarse sun sensors). Four small reactions wheels will generate torque for attitude command, and are de-saturated using magnetic torquers. In addition, a Global Positioning System (GPS) receiver provides satellite position information for accurate orbit ephemeris determination and on board time delivery.

The PROTEUS pointing accuracy, which is better than 0.03 deg on flight, was improved for the COROT mission by using the instrument information in the attitude control loop, achieving 1 arcsec accuracy.

Mechanical design

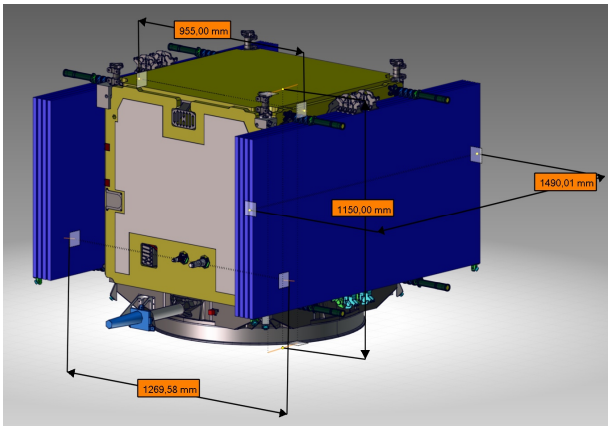
The core of the PROTEUS structure design is a cubic Aluminium chassis (1 m3), on which honeycomb lateral panels are mounted. This concept draws its heritage from the Globalstar satellite structure. A 937mm diameter launcher adapter is mounted on the bottom plate.

The Payload mechanical interface consists of four bolt interfaces to facilitate mounting or dismounting. Volume allocation depends on launcher fairing.

Thermal Control Means

The PROTEUS thermal control concept relies on passive radiators (1.88m² available surface), and active regulation through heaters driven by the computer.

The platform is highly decoupled from the payload to control its temperature in the range [-10°C, +40°C] in all modes.



PROTEUS in stowed configuration

Propulsion

The Propulsion subsystem is a segregated module manufactured in parallel to facilitate platform integration and tests.

The PROTEUS platform uses a monopropellant type propulsion system with Hydrazine pressurised by Nitrogen gas. The four 1N thrusters are oriented toward -X on the bottom of the platform to limit the risk of payload contamination.

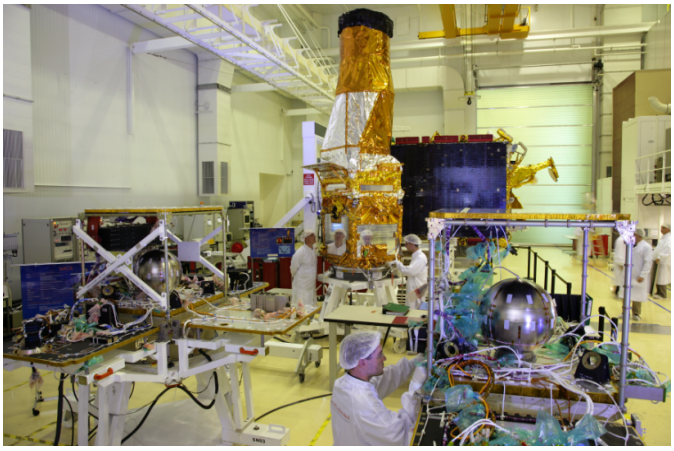
PROTEUS technical data

Flight domain	Low Earth Orbits (from 600km up to 1500km); Inclination > 20 Deg
Launcher compatibility	Ariane 5, Athena 2, Cosmos, Delta 2, LM-2D, PSLV, Rockot, Soyuz and Taurus
Mass Allocation	Platform: 300 kg & Payload: 300 kg
Power supply	300 W Platform & 300 W Payload 23V-37V unregulated bus Li-Ion battery (9s/3p cells)
Solar Arrays	2 wings with 4 panels (1.5*0.8m² each) 1.1 kW Beginning Of Life
Payload electrical I/F	16 power lines + point-to-point link + Bus MIL 1553 B (160 kbps)
Data Storage	500 Mbits Housekeeping + 2 Gbits Payload data storage
TM/TC	722 kbps TM/QPSK & 4 kbps TC/BPSK
Propulsion	28 kg max monopropellant N2H4 with N2 pressurant Unregulated pressure (22 bars - 5.5 bars End Of Life)
Manœuvres	4*1N Thrusters performing 120 m/s (according SC mass of 500 kg)
Pointing mode	Earth, Nadir, Sun, inertial, including Sun synchronous orbits
Pointing accuracy	72 arc-sec per axis
Stability	2.5 arc-sec/sec (excluding payload perturbations)
Reliability	0.759 over 5 years and 0.882 over three years
Unavailability	0.82 % (0.25% = failures, 0.50% = radiation, 0.07% = orbit correction)
On flight heritage	JASON21 CALIPSO, JASON2, COROT and SMOS

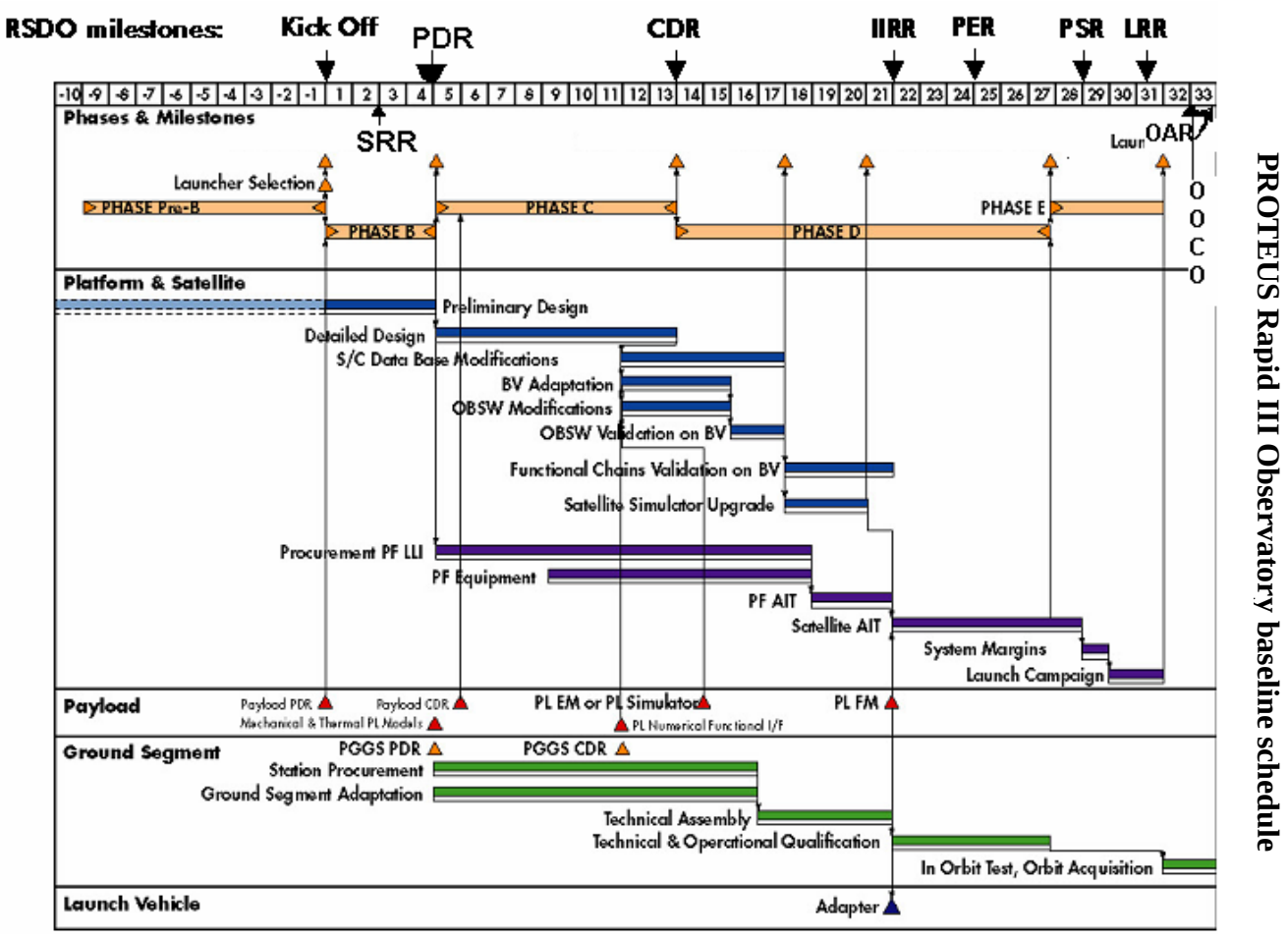
PROTEUS Rapid III SC Delivery Schedule

The generic schedule from Kick Off until launch is around 32 months, based on a standard platform, with adaptations limited to “missionization”.

TAS Cannes facilities are tailored to perform Observatory system integration and tests, and include: four thermal vacuum chambers (50 up to 500 m^3), an indoor Compact Antenna Test Range, two shaker tables, and a new acoustic chamber. Validation tools (avionics test bench and simulators) are maintained to support PROTEUS product line modifications.



The Corot Observatory, Jason 2 and SMOS satellites within the TAS Cannes clean room



PROTEUS Rapid III Observatory baseline schedule

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